



Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

October 2, 2014

10 CFR 50.73

ATTN: Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 1  
Facility Operating License No. NPF-90  
NRC Docket Nos. 50-390

Subject: **Licensee Event Report 50-390/2013-004 Supplement 1**

Enclosed please find Licensee Event Report (LER) 50-390/2013-004-01 that has been prepared and submitted pursuant to 10 CFR 50.73. This LER reports a Unit 1 plant trip that occurred on June 28, 2013 and has been supplemented with additional information on the event cause revealed from ongoing investigations. This condition is reported as an LER in accordance with 10 CFR 50.73(a)(2)(iv)(A), as an event or condition that resulted in an automatic actuation of a safety system.

There are no new regulatory commitments contained in this submittal. Should you have questions regarding this LER, please contact Gordon Arent, WBN Site Licensing Director, at (423) 365-2004.

Respectfully,

A handwritten signature in dark ink, appearing to read "Kevin T. Walsh, Sr.", written over a light blue horizontal line.

Kevin T. Walsh, Sr.  
Site Vice President  
Watts Bar Nuclear Plant

Enclosure

cc (Enclosure):

NRC Regional Administrator - Region II  
NRC Senior Resident Inspector - Watts Bar Nuclear Plant, Unit 1  
NRC Project Manager - Watts Bar Nuclear Plant

## LICENSEE EVENT REPORT (LER)

Estimated burden per response to comply with this mandatory collection request: 80 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to FOIA/Privacy Section (T-5 F53), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to [infocollects.resource@nrc.gov](mailto:infocollects.resource@nrc.gov), and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

## 1. FACILITY NAME

Watts Bar Nuclear Plant (WBN) Unit 1

## 2. DOCKET NUMBER

05000390

## 3. PAGE

1 of 5

## 4. TITLE

Plant Trip on 500kV Transmission Line Fault

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
06	28	2013	2013	- 004	- 01	10	02	2014	FACILITY NAME	DOCKET NUMBER

## 9. OPERATING MODE

1

## 10. POWER LEVEL

100

## 11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

- |   |   |  |   |
|---|---|--|---|
| <input type="checkbox"/> 20.2201(b)         | <input type="checkbox"/> 20.2203(a)(3)(i)   | <input type="checkbox"/> 50.73(a)(2)(i)(C)             | <input type="checkbox"/> 50.73(a)(2)(vii)     |
| <input type="checkbox"/> 20.2201(d)         | <input type="checkbox"/> 20.2203(a)(3)(ii)  | <input type="checkbox"/> 50.73(a)(2)(ii)(A)            | <input type="checkbox"/> 50.73(a)(2)(viii)(A) |
| <input type="checkbox"/> 20.2203(a)(1)      | <input type="checkbox"/> 20.2203(a)(4)      | <input type="checkbox"/> 50.73(a)(2)(ii)(B)            | <input type="checkbox"/> 50.73(a)(2)(viii)(B) |
| <input type="checkbox"/> 20.2203(a)(2)(i)   | <input type="checkbox"/> 50.36(c)(1)(i)(A)  | <input type="checkbox"/> 50.73(a)(2)(iii)              | <input type="checkbox"/> 50.73(a)(2)(ix)(A)   |
| <input type="checkbox"/> 20.2203(a)(2)(ii)  | <input type="checkbox"/> 50.36(c)(1)(ii)(A) | <input checked="" type="checkbox"/> 50.73(a)(2)(iv)(A) | <input type="checkbox"/> 50.73(a)(2)(x)       |
| <input type="checkbox"/> 20.2203(a)(2)(iii) | <input type="checkbox"/> 50.36(c)(2)        | <input type="checkbox"/> 50.73(a)(2)(v)(A)             | <input type="checkbox"/> 73.71(a)(4)          |
| <input type="checkbox"/> 20.2203(a)(2)(iv)  | <input type="checkbox"/> 50.46(a)(3)(ii)    | <input type="checkbox"/> 50.73(a)(2)(v)(B)             | <input type="checkbox"/> 73.71(a)(5)          |
| <input type="checkbox"/> 20.2203(a)(2)(v)   | <input type="checkbox"/> 50.73(a)(2)(i)(A)  | <input type="checkbox"/> 50.73(a)(2)(v)(C)             | <input type="checkbox"/> OTHER                |
| <input type="checkbox"/> 20.2203(a)(2)(vi)  | <input type="checkbox"/> 50.73(a)(2)(i)(B)  | <input type="checkbox"/> 50.73(a)(2)(v)(D)             | Specify in Abstract below or in NRC Form 366A |

## 12. LICENSEE CONTACT FOR THIS LER

## FACILITY NAME

Russell A. Stroud, Sr. Program Manager, WBN Site Licensing

## TELEPHONE NUMBER (Include Area Code)

423-365-1435

## 13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

## 14. SUPPLEMENTAL REPORT EXPECTED

☐ YES (If yes, complete 15. EXPECTED SUBMISSION DATE) ☒ NO

## 15. EXPECTED SUBMISSION DATE

MONTH	DAY	YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

On June 28, 2013, an A-phase ground fault occurred on the Roane 500kV transmission line approximately 22 miles from Watts Bar Nuclear Unit 1 (WBN1). Concurrently, WBN1 experienced a reactor trip due to the actuation of the 1A Main Bank Transformer Feeder Differential Relay. The 500kV transmission line fault was caused by a tree that fell onto the A-phase of the transmission line. The tree was cut by a local land owner.

Operations personnel stabilized the plant using the Auxiliary Feedwater (AFW) System and the main steam dump valves. The secondary-side steam generator (SG) atmospheric relief valves, SG power operated relief valves (PORVs) and SG safety valves were not challenged during the transient. The Reactor Coolant System (RCS) responded to the initial plant transient as expected without actuating Pressurizer PORVs or initiating Safety Injection signals.

The cause of the event was determined to be an incorrectly de-terminated current transformer neutral conductor that caused a differential relay imbalance in the summation circuit during the faulted conditions.

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## NARRATIVE

## I. EVENT DESCRIPTION

## A. Reporting Criteria

This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) as an event or condition that resulted in the actuation of the reactor protection system (RPS) when the reactor was critical and automatic actuation of the auxiliary feedwater (AFW) system. This event was reported via the event notification system on June 28, 2013 (reference EN# 49154).

## B. Plant Operating Conditions Before the Event

Prior to the event on June 28, 2013, Watts Bar Nuclear Plant Unit 1 (WBN1) was in MODE 1 operating at approximately 100 percent rated thermal power. There were no structures, systems, or components that were inoperable at the start of the event that contributed to the event. Event times are reported relative to Eastern Daylight Savings Time.

## C. Operator Actions

On June 28, 2013 at 13:29:45, an A-phase ground fault occurred on the Roane 500kV transmission line approximately 22 miles from WBN1. Concurrently (13 cycles later), WBN1 experienced a reactor trip due to the actuation of the 1A Main Bank Transformer Feeder Differential Relay (187TF) [Energy Industry Identification System (EIIS): RLY61]. The 500 kV transmission line fault was caused by a tree that fell onto the A-phase of the transmission line (schematic in Section V, Additional Information). The tree was cut by a local land owner.

Operations personnel promptly entered reactor trip procedures to ensure proper automatic protection system response, to assess plant conditions, and to identify the appropriate recovery instructions.

Operations personnel stabilized the plant using the Auxiliary Feedwater (AFW) System and the main steam dump valves. The secondary-side steam generator (SG) atmospheric relief valves, SG power operated relief valves (PORVs) and SG safety valves were not challenged during the transient. The Reactor Coolant System (RCS) responded to the initial plant transient as expected without actuating Pressurizer PORVs or initiating Safety Injection signals.

Post-trip, plant equipment responded as expected with the following exceptions: 1) an intermediate position indication on a single Condenser Main Steam Dump Valve changed to full-closed at approximately the same time as receipt of RCS Low-Low average temperature signal as the plant cooled down due to AFW flow, 2) the Main Turbine Seal Oil Backup Pump failed to start automatically and Operations personnel manually started it from the Main Control Room, and, 3) secondary water inventory overflowed through the Condensate Storage Tank (CST) due to an automatic system diversion to maintain condenser hotwell level. Chemistry personnel sampled the CST overflow and concluded it did not pose adverse chemical or radiological hazards.

Operations personnel confirmed the plant response post-trip was uncomplicated, and a team was established post-trip to perform a formal cause analysis of this event. The cause of the trip was determined to be an unexpected operation of the A-Phase Main Bank Transformer 187TF differential relay associated with a line-to-ground fault on the 500kV Roane transmission line.

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**D. System Description and Status**

The plant is connected into a 500kV transmission grid. The 500kV Switchyard is a double breaker - double bus configuration. Each unit and each of five 500kV transmission lines can be connected to either or both buses through a single 500kV breaker. No system anomalies were noted prior to the event.

**E. Component Information**

Turbogenerator protective trips will automatically trip the turbine due to turbine (mechanical) and generator (electrical) abnormalities. The Main Transformer Feeder Differential Trip (187TF) is designed as an automatic turbine trip feature to protect the generator from electrical abnormalities.

The 187TF relay circuit is a simple current differential scheme summing currents from three different sources and passing that sum (on a per-phase basis) through a set of short-time overcurrent (GE IAC55) relays [EIS: RLY51]. The current transformers (CTs) [EIS: XCT] feeding the circuit are C800, 3000/5 set on full ratio, so the C800 accuracy class applies. The three sources are 5084 bushing CTs (SF6 dead-tank breaker [EIS: BKR]), 5088 free-standing CTs (airblast live-tank breaker [EIS: BKR]), and GSU 500kV bushing CTs. Performance of the three CTs is deemed comparable due to the common C800 rating.

Under normal conditions and external faults, the current in the relays should be near zero. During internal faults, the system is designed such that the currents from all three CTs would sum together resulting in relay actuation, a lockout relay operation and tripping of the 500kV breakers with a subsequent reactor trip. The 500kV transmission line fault should not have actuated the 187TF relay.

**II. SAFETY CONSEQUENCES**

**A. Safety Limits and Limiting Safety System Settings**

No plant safety parameters exceeded their anticipated limits during this event, and no radiological and chemistry abnormalities were encountered post-trip. No safety functions were prevented or inhibited during this event and off-site power capabilities were maintained with the plant safety features responding as designed. There were no safety systems that were rendered inoperable or discovered to be degraded during this event and designed redundancy was maintained. There were no safety system functional failures.

**B. Automatically and Manually Initiated Safety System Responses**

The plant trip occurred when A-Phase protective differential relay 187TF received current above the actuation setpoint of 1.5 amperes (A) (i.e., registered a false fault in protected zone). The relay responded by actuating the 186GB relay [EIS: RLY94] resulting in a turbine trip. Since the reactor was above 50 percent power, the turbine trip resulted in an automatic reactor trip. When the main feedwater pumps tripped, an automatic start of all Auxiliary Feedwater (AFW) Pumps was initiated. There were no safety system failures that adversely affected technical specification parameters/conditions during this event. Post-trip review revealed that the event was not a scram with complications.

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C. Manufacturer and Model Number (or other identification) of each component that failed during the event

There were no component failures associated with this event.

D. Method of Discovery of Each Component or System Failure or Procedural Error

The root cause evaluation identified that a human performance error occurred associated with the implementation of switchyard design modifications completed in 2011.

**III. CAUSE OF THE EVENT**

A. The cause of each component or system failure or personnel error, if known:

TVA conducted testing during the spring 2014 refueling outage which revealed the cause of the event was an incorrectly de-terminated current transformer neutral conductor which caused a differential relay imbalance in the summation circuit, during the faulted conditions.

B. The cause(s) and circumstances for each human performance related cause:

The neutral conductor was de-terminated during design modifications to convert the WBN switchyard to a double-bus, double-breaker configuration and upgrade various metering functions. A field data sheet used to implement the design modifications erroneously directed that a neutral conductor be de-terminated. The current transformer neutral conductor was de-terminated in the spring of 2011.

**IV. CORRECTIVE ACTIONS**

A. Immediate Corrective Actions

The neutral conductor was re-terminated in accordance with design documents.

B. Corrective Actions to Prevent Recurrence or to reduce probability of similar events occurring in the future

In order to confirm that the cause had been identified and to ensure that no intermittent condition existed, TVA installed a monitoring system (Astro-Med TMX) which could confirm the existence of sustained or transient circuit imbalances without having to wait for a system disturbance. Additionally, the system's numerous discrete inputs allowed TVA to discern localization of an issue to a particular phase of a particular CT circuit should additional anomalies be observed.

**IV. PREVIOUS SIMILAR EVENTS**

A review of internal operating experience did not reveal any previous events or conditions that involved the same underlying concern or reason as this event, such as the same root cause, failure, or sequence of events.

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## V. ADDITIONAL INFORMATION

### Protective Relay Scheme

